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INVESTIGATION OF UTILIZING STATIC DEHUMIDIFICATION CONCEPTS IN --ETC(U)
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INVESTIGATION OF UTILIZING STATIC DEHUMIDIFICATION CONCEPTS IN VANS AND SHELTERS,

AFALD/PTPD
AIR FORCE PACKAGING EVALUATION AGENCY
Wright-Patterson AFB OH 45433

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NOTICE

ABSTRACT

Static free breather dehumidification systems have been continually experimented with for over thirty years. Its potential has been demonstrated but never effectively implemented within the Air Force. At this time of high cost impact and no active military engagements, proper long term storage must be achieved to maintain an effective defense. Static free breather dehumidification systems will help satisfy this requirement.

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INTRODUCTION

PURPOSE:

This investigation was conducted to provide insight into the possibility of utilizing static dehumidification equipment on CEM vans, shelters, and other containers in storage. This task was accomplished by investigating previous efforts and analyzing their results to establish specific guidelines for an effective method of dehumidification. Results of this project will emphasize Air Force requirements for extended periods of storage and inspections.

BACKGROUND:

The need for a more cost effective dehumidification system is a result of increased usage and subsequent protection of electronics in the military environment. Capabilities have been greatly expanded by utilizing recent advances in the electronics industry. Accompanying the increased utilization of electronics has been increased costs. Not surprisingly these electronics must last longer, perform better, weigh less, and require less maintenance. They must be dependable in their intended function. The failure of one component may amount to the loss of considerable dollars, aircraft, or mission failure. Ironically, a failure may be caused by a minuscule particle shorting out a circuit which is so small it cannot be detected without the aid of sophisticated equipment.

Delicate parts must be provided with a dehumidified storage environment to prevent corrosion and deterioration of the system's capability. If this corrosion free environment is provided, many dollars will be saved from lower inspection frequencies and fewer replacement parts required for transition to the operational mode. At the same time, the system will be more dependable, have less down time, and be operationally ready in a shorter period of time.

The above points have been known for many years, consequently, several good studies and test program results are available to base decisions upon. However, at this point in time, no comprehensive set of guidelines or policy has been effectively implemented. This is the main thrust of current efforts by the AFPEA.

PREVIOUS EFFORTS

GENERAL:

Three major studies have been extensively researched and in-

vestigated along with several other applicable items of interest. These three studies are examined in chronological order in this section. Their recommendations and conclusions were utilized to assist in determining the guidelines which are presented later in this report.

Effort 1. In 1945-1949 a three year test program was conducted to evaluate the theory of operation of a Solar Radiation Breather. This breather was designed by the Davison Chemical Corporation for the Ordnance Department of the U.S. Army.

The basic concept of the Solar Radiation Breather was to utilize the sun's rays to drive out moisture from a desiccant bed during the out breathing cycle of a container. In this manner, the life of the desiccant may be greatly extended.

Test results formulated the following two conclusions as printed in the April 1949 edition of Heating and Ventilating:

"(1) Neither complete reactivation nor exhaustion of the silica gel ever occurs, rather the silica gel in the breather tends to approach an equilibrium condition dependent upon both the ambient psychrometric conditions and the humidity prevailing inside the container. This equilibrium will never quite be attained because the dependent conditions are constantly changing.

(2) While the breather will maintain a satisfactory preservation level of humidity inside a tight, correctly engineered container, it is not a corrective device, that is, it will not remove appreciable quantities of water from a wet pack. The contents of the container must be properly predried so that the stored materials are in equilibrium with the desired humidity level and a sufficient amount of flywheel desiccant must be added; further, the container must be tight, since leaks permit moisture to enter without passing through the breather."

The results also showed that with an initial pulldown load of desiccant inside the container, the humidity remained under 25 percent RH during the entire test. Thus, for at least three years, a well preserved pack was maintained without changing desiccant nor opening the container.

Effort 2. In November 1965, a one year test was concluded to compare static dehumidification with dynamic dehumidification. Performed by the U.S. Army Supply and Maintenance Command Packaging, Storage, and Transportability Center at Tobyhanna Army Depot, the test utilized free breathing static dehumidification equipment.

The basic concept of the free breathers was to vent any pressure differentials through a bed of desiccant and a breather tube. In this way, moisture would be removed from the incoming air by the desiccant while moisture migration was prevented by the breather tube during the absence of pressure differentials. It was also noted that this system relieved pressures which could cause failure of gaskets to seal.

Two of the conclusions published in the November 1965 report were:

"a. Static free breather dehumidification systems can provide an economical means for reducing the deterioration of equipments contained in vans and shelters.

b. The performance of static free breather dehumidification systems is dependent to a large degree upon the proper design and application of the components of the static free breather equipment and the tightness of the shell of the individual van or shelter used."

In addition, some basic construction requirements were discussed in detail. Results were enthusiastically received and widespread implementation recommended.

Effort 3. In 1969 a two year environmental test was begun to determine relative effects of design variables on metal containers. Performed by Ryco Engineering, Inc., under contract from the U.S. Army Tank Automotive Command, Packaging Engineering Branch, this test utilized free breathers, controlled breathers, and pressurized containers for comparative purposes.

In this test the free breathers functioned without the benefit of a breather tube. The controlled breathers used pressure relief valves to automatically release any pressure buildup. Some of the conclusions presented in the final report on this project were:

a. "Based on the data obtained thus far, we believe that both free-breathers and controlled-breathers can be developed which will fulfill all the requirements for reusable shipping and storage containers. Depending on the length of storage required, each type of container has cost and effectiveness merits, and each should be retained in the system."

b. "For extended storage periods of up to 5 years, or even 10 years, in ventilated shade, the controlled breather provides the best answer. This type of container can, when properly designed, hold internal relative humidity under 40% for this period of time.

This should make controlled breathers an acceptable substitute for pressurized containers."

c. "For short storage periods of up to 1 1/2 years, (up to 3 years, in ventilated shade) the free-breathers can be properly designed for effective storage at a low cost."

As was the case in Effort 2, many basic design requirements and considerations were discussed.

DEVELOPED GUIDELINES

From the accumulated results of these efforts and other related information, some general guidelines may be presented for static dehumidification. Two types of breather systems, free-breathing and controlled-breathing, were discussed in the previous section. The free-breathing system is presented here as the most preferable type since it reduces the sealing capability requirement. That is, the container does not have to remain hermetically sealed up to a given pressure, consequently allowing a free breather system to relieve pressure which may have caused leakage through the gaskets. The free breather system is subdivided into solar rejuvenated static dehumidification systems and internal static dehumidification systems. Based on previously accumulated data, these systems will provide effective preservation during storage.

General container requirements for utilizing these systems are: (1) long term outside or covered and uncontrolled environmental storage (over six months) will be encountered and (2) the containers are capable of achieving an airtight seal at low pressure differentials (less than .5 psig). With these two requirements satisfied, the container may be fitted with a free breather system.

If a free breather system is chosen, the container must be modified, if not already equipped with breather provisions, to accept a breather system. Depending upon the equipment chosen, it is installed inside or outside the container and the vent tube properly connected. Immediately prior to sealing the container, the breather system is activated with thoroughly dried desiccant and a bring down load of desiccant placed inside the container which is then sealed. The quantity of desiccant seems to be a debatable issue. Until the issue is settled, desiccant quantities should be calculated in accordance with MIL-P-116.

Specific equipment guidelines may be enumerated by the following:

1. Basic idea is to vent all incoming and outgoing air through a bed of desiccant.

2. The desiccant bed is vented to the outside by a breather tube having a length to diameter ratio of at least 13 to 1. The tube must be fabricated from a material with a very low water vapor transmission rate.

3. The design should minimize pressure buildup due to flow restriction while keeping the vent tube air velocity to a minimum.

4. The outside air's point of entry must be impervious to rain, dirt, insects, animals, birds, and other contaminants.

5. If the equipment is mounted externally on the container, it should be free from corroding and be mechanically fastened to withstand any environmental conditions to be encountered.

TWO EXAMPLES:

The first example shows various applications and details of static free breather systems previously experimented with. Figure 1 diagrams one possible breather system. This specific system was used in Effort 2 of the efforts presented above. Some of its applications are shown in Figures 2, 3, and 4.

The second example of a free breather system is shown in Figure 5. This system is a solar rejuvenator system, similar in concept to the Effort 1 system. Figure 6 is a detailed view of this system. Theoretically, the solar rejuvenated system will have infinite life as the sun continually partially reactivates the desiccant.

CONCLUSIONS

Wide spread utilization of the free breather concept is necessary to obtain maximum benefits for long term storage of electronic vans and shelters. Air Force packaging activities responsible for design or specifying requirements should implement the free breather concept in items such as electronic vans and shelters, large equipment containers, missile containers, and any other potential uses requiring long term storage. If additional container/van/shelter, etc. information regarding the free breather system concept is required, contact AFALD/PTPD, AUTOVON 787-3120 or commercial (513) 257-3120 for assistance.

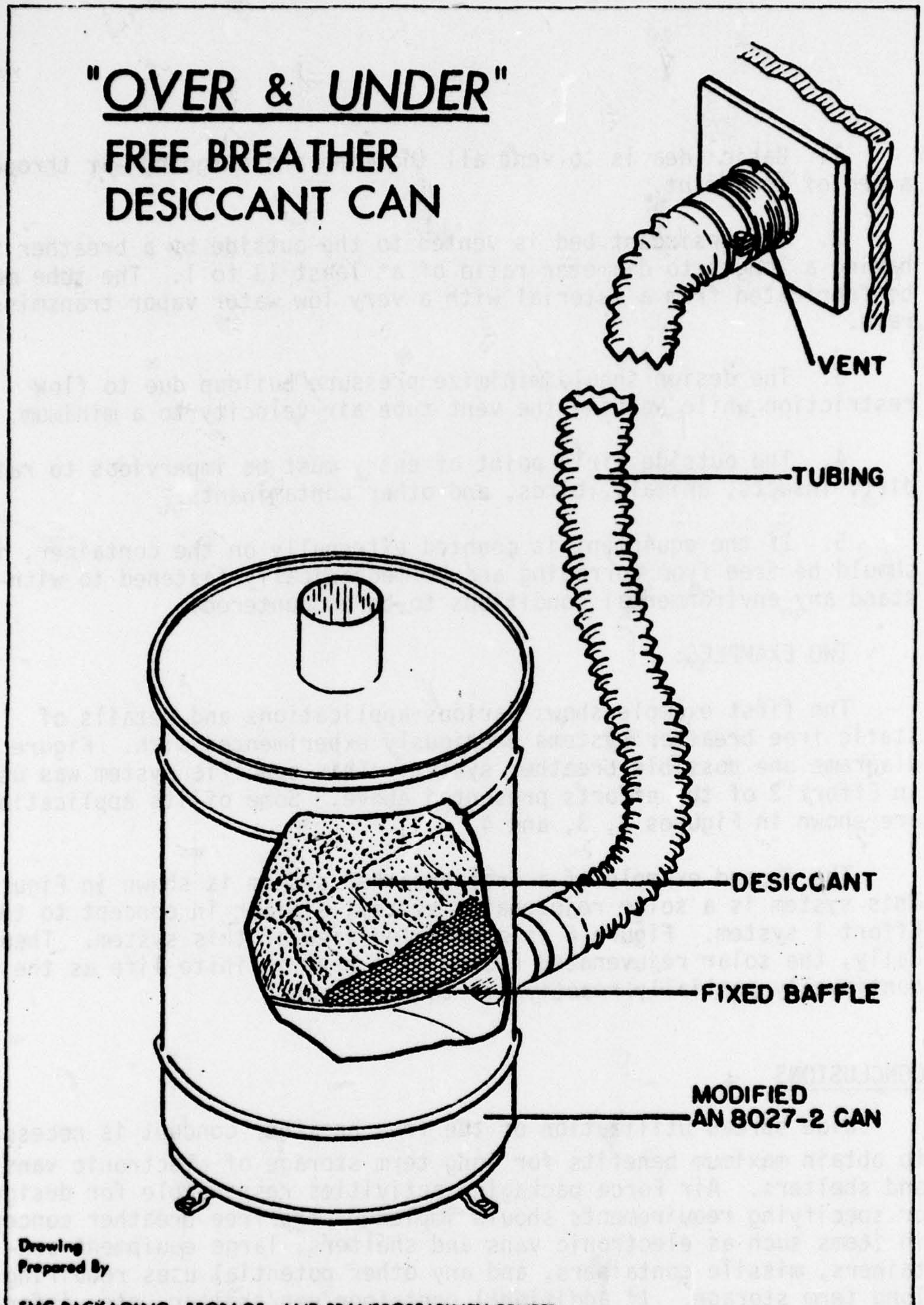

FIGURE 1. A FREE BREATHER SYSTEM UTILIZED IN EFFORT 2.

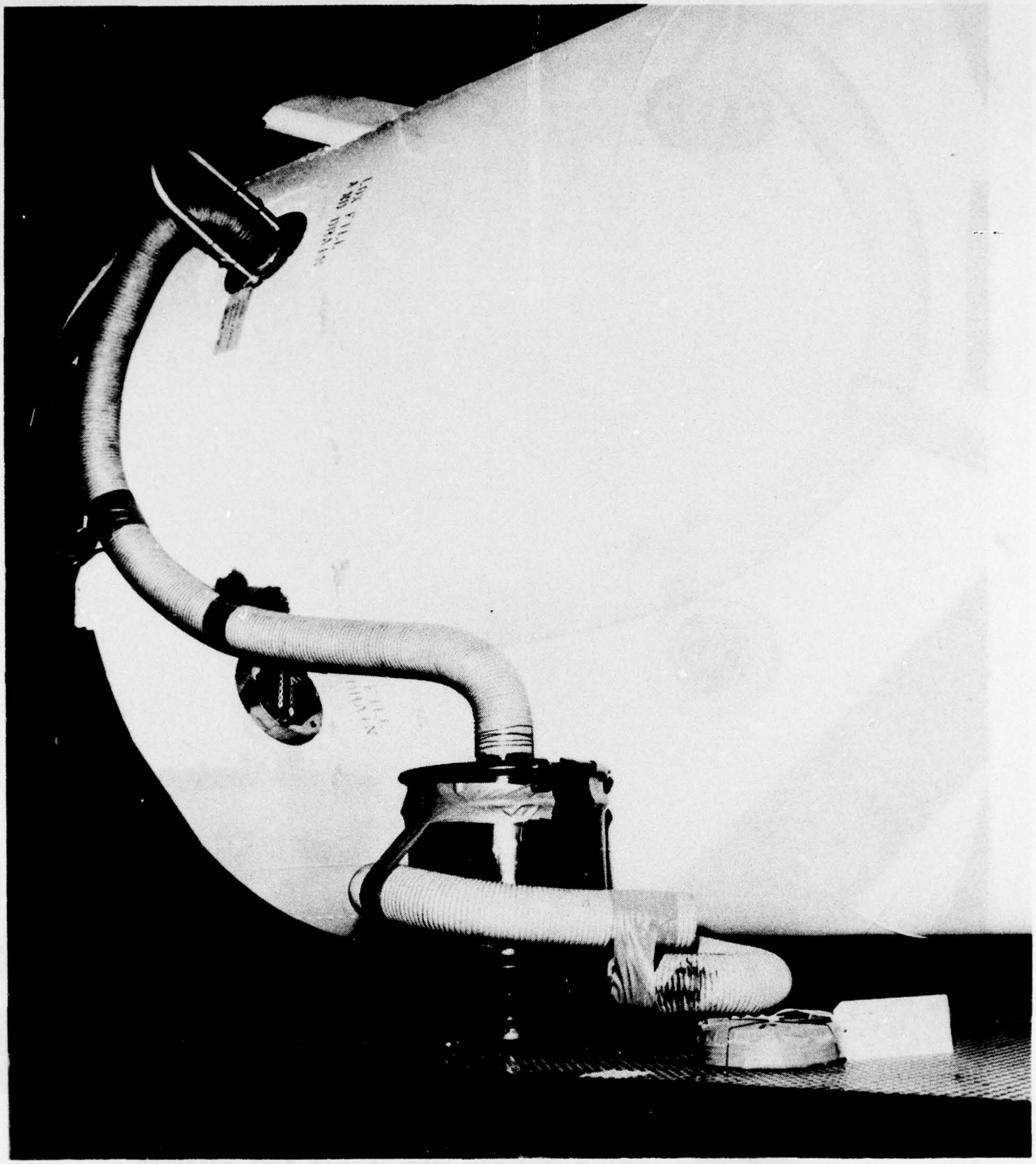

FIGURE 2. U.S. ARMY PHOTOGRAPH OF A FREE BREATHER SYSTEM USED ON A LOX TANK.

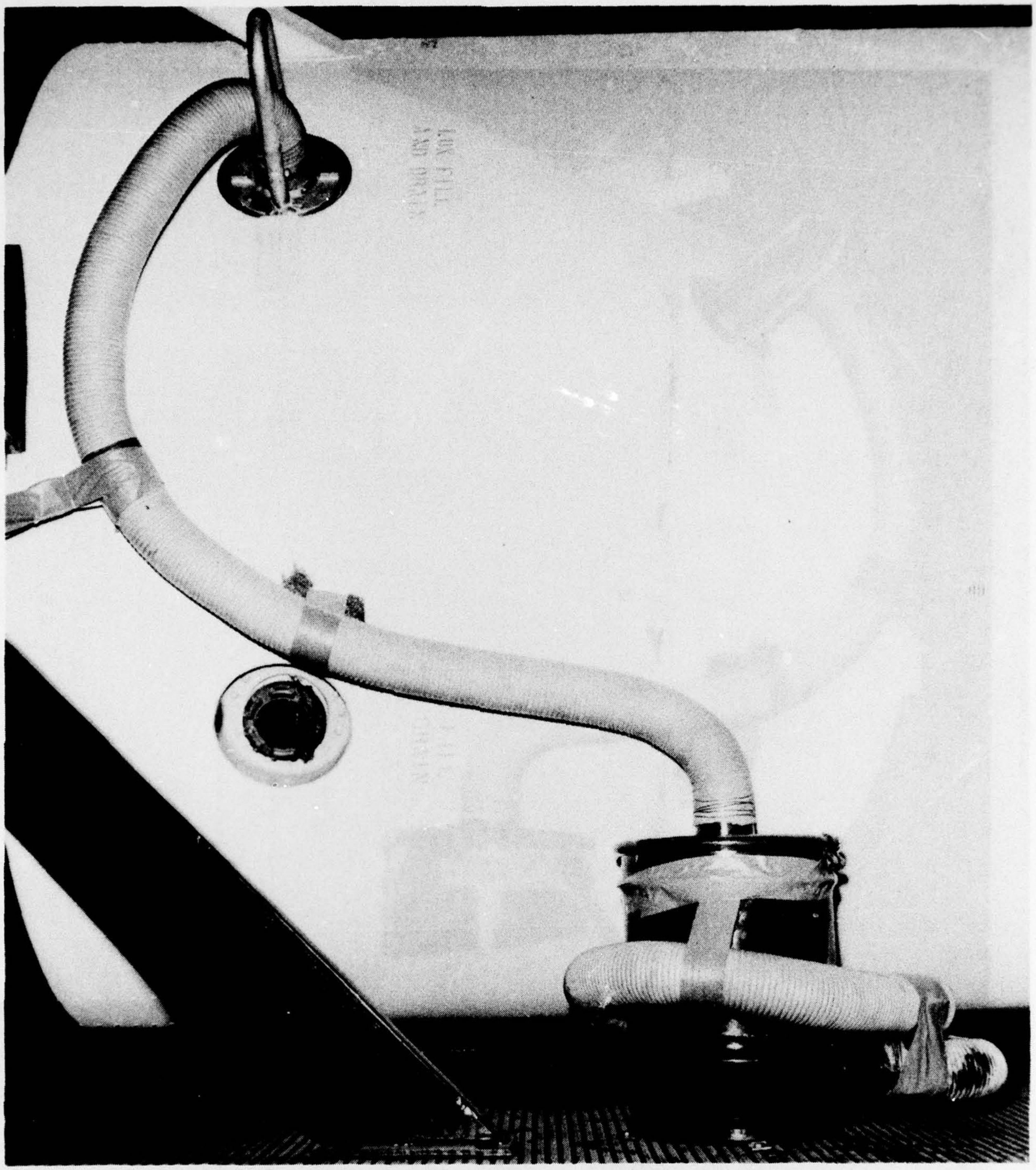

FIGURE 3. U.S. ARMY PHOTOGRAPH SIDE VIEW OF FREE BREATHER.

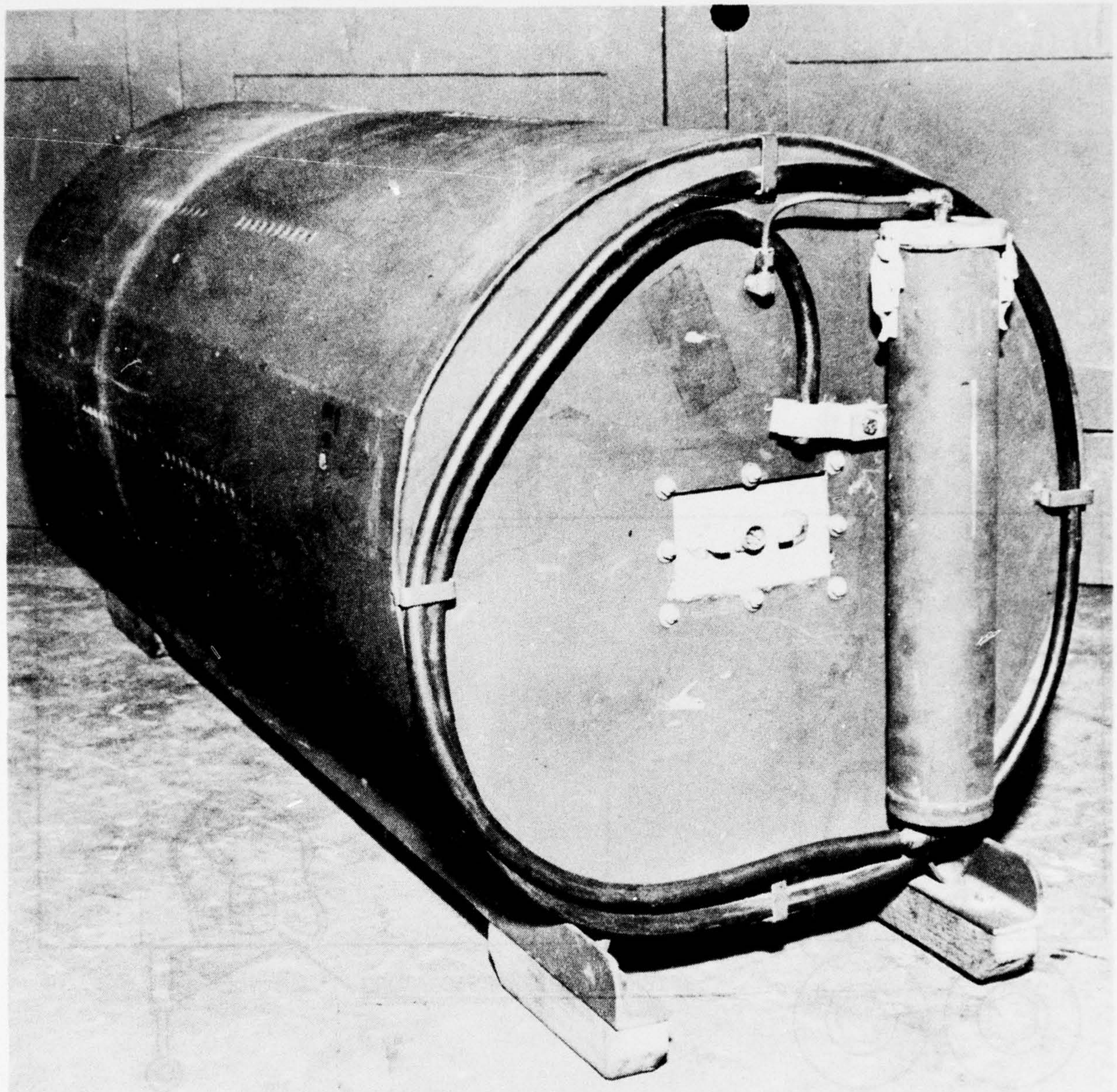

FIGURE 4. BREATHER SET UP DURING A 1957 TEST AT WHITE SANDS PROVING GROUNDS.

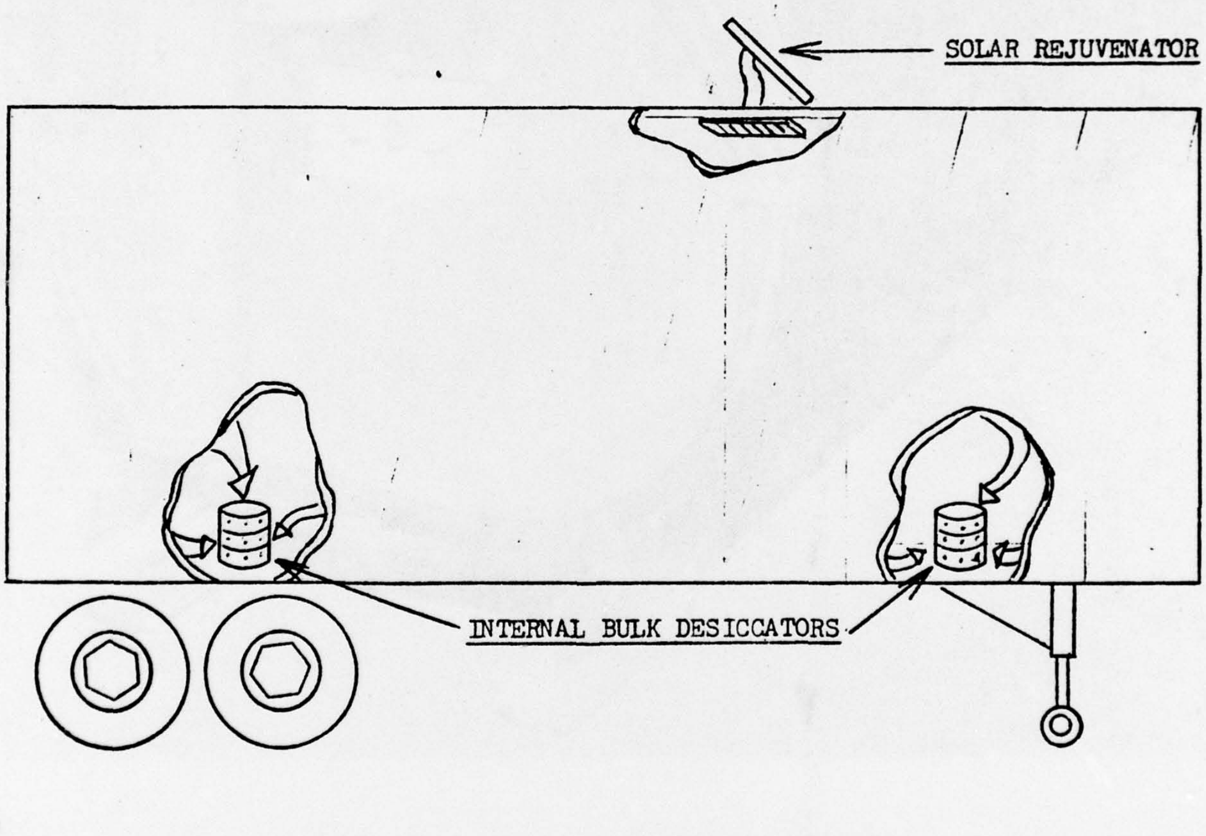

FIGURE 5. A POSSIBLE SOLAR REJUVENATOR SYSTEM FOR LONG TERM VAN STORAGE.

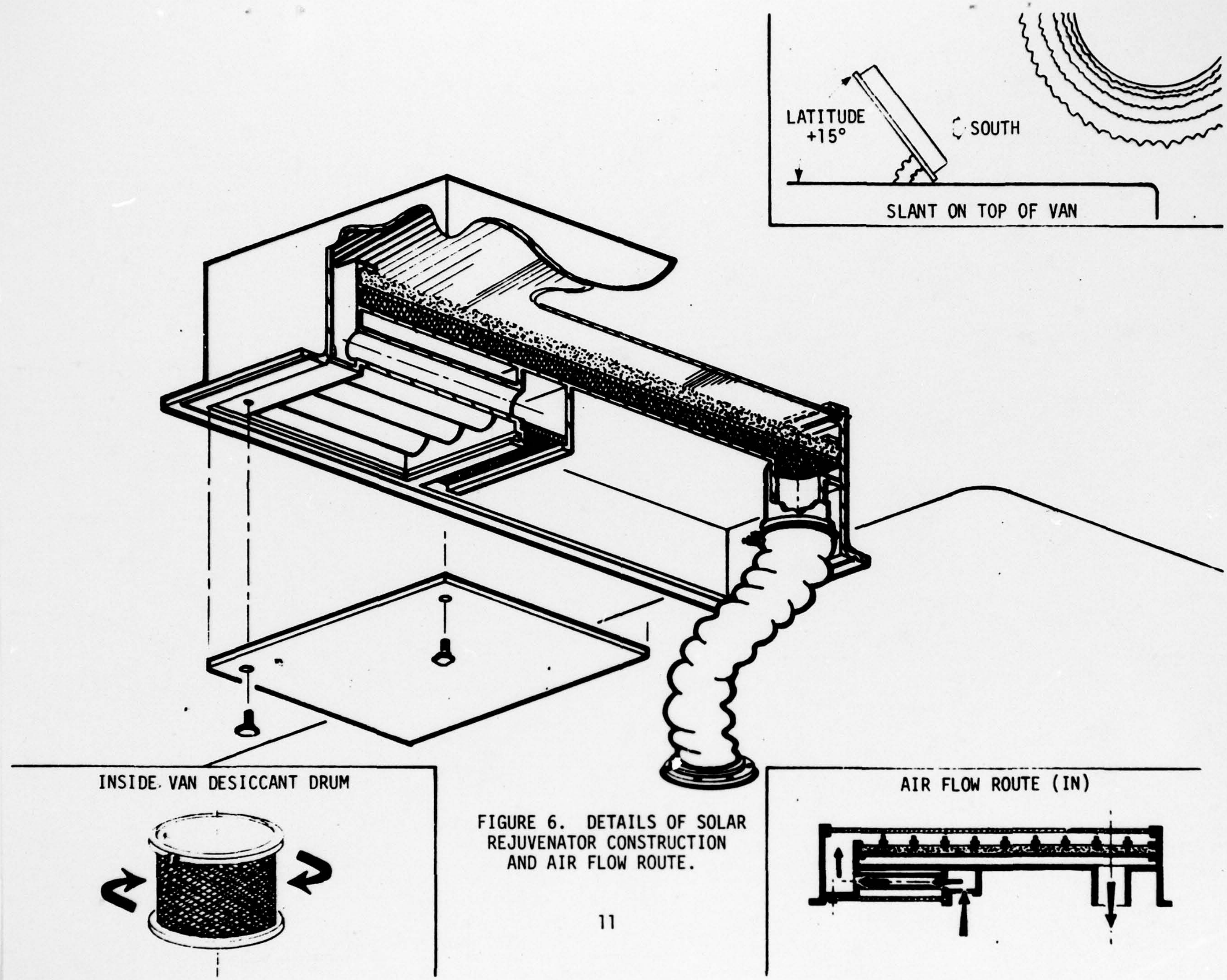

FIGURE 6. DETAILS OF SOLAR REJUVENATOR CONSTRUCTION AND AIR FLOW ROUTE.

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